FLY SWARMS and complexity

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THE INTRODUCTION

Complexity is the study of phenomena that emerge from a collection of interacting objects. Complexity arises in many systems throughout physics, biology, finance and economics. Certain kinds of complex systems can be described by Self-Organized Criticality (SOC). First posited by Bak et. al in 1987, SOC systems are described as "...dynamical systems with extended spatial degrees of freedom...[that] naturally evolve into a self-organized state."* Put simply, it's a system that is internally driven towards some critical point.

*P. Bak, C. Tang, and K. Wiesenfeld, Phys. Rev. Lett. 59, 381 (1987)

Representation of the classic example.

Brief video overview of SOC systems for the curious minds.

http://bit.ly/SOCbackground

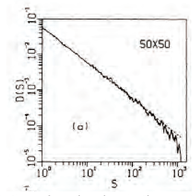
THE MOTIVATION

Recent experimental work suggests scaling behavior of fly swarms. Our goal is to look for SOC behavior in computational models of fly swarms.

A swarm of midges.

Alessandro Attanasi et al., "Finite-Size Scaling as a Way to Probe Near-Criticality in Natural Swarms," Phys. Rev. Lett. 113, 238102 (2014)

THE CLASSIC EXAMPLE

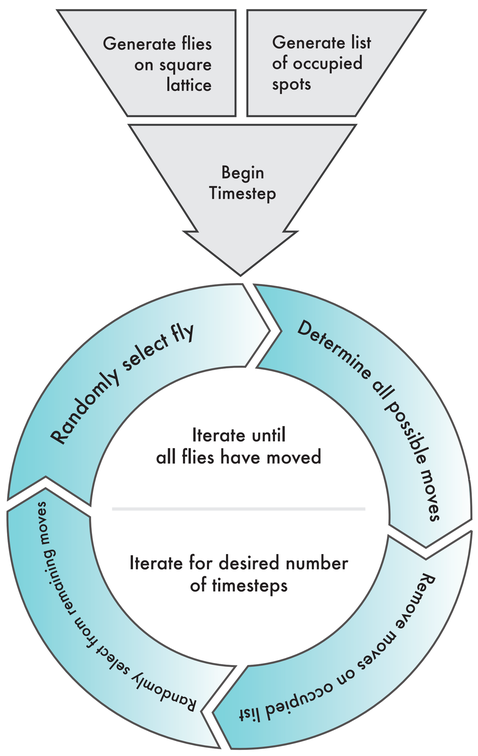


*Size distribution of avalanches in the sandpile model.**

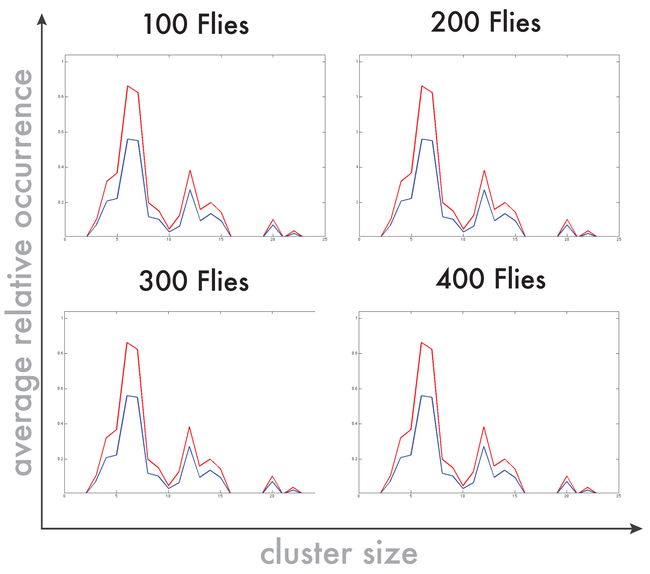
Characteristic	Sandpile	Fly Swarms
Random Pertubation	Adding a grain of sand	Movement of fly
Critical Threshold	Slope of pile	Density of flies?
Method of Relaxation	Avalanche	Enter/Exit Swarm?

P. Bak, C. Tang, and K. Wiesenfeld, Phys. Rev. Lett. 59, 381 (1987)

THE ALGORITHM



THE RESULTS & ANALYSIS



Timestep 1

Timesteps 25, 50, 75, 100

THE FUTURE WORK

- Add attractive force to get swarming behavior
- Add in velocity coupling
- Program more realistic flight behavior

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